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II. *An Argument for Divine Providence, taken from the conſtant Regularity obſerv'd in the Births of both Sexes. By Dr.* John Arbuthnott, *Phyſitian in Ordinary to Her Majeſty, and Fellow of the College of Phyſitians and the Royal Society.*

AMong innumerable Footſteps of Divine Providence to be found in the Works of Nature, there is a very remarkable one to be obſerved in the exact Ballance that is maintained, between the Numbers of Men and Women; for by this means it is provided, that the Species may never fail, nor periſh, ſince every Male may have its Female, and of a proportionable Age. This Equality of Males and Females is not the Effect of Chance but Divine Providence, working for a good End, which I thus demonſtrate:

Let there be a Die of Two ſides, M and F, (which denote Croſs and Pile), now to find all the Chances of any determinate Number of ſuch Dice, let the Binome M+F be raiſed to the Power, whoſe Exponent is the Number of Dice given; the Coefficients of the Terms will ſhew all the Chances ſought. For Example, in Two Dice of Two ſides M+F the Chances are $M^2+2\,MF+F^2$, that is, One Chance for M double, One for F double, and Two for M ſingle and F ſingle; in Four ſuch Dice there are Chances $M^4+4\,M^3F+6\,M^2F^2+4\,MF^3+F^4$, that is, One Chance for M quadruple, One for F quadruple, Four for triple M and ſingle F, Four for ſingle M and triple F, and Six for M double and F double; and univerſally, if the Number of Dice be n, all their Chances will be expreſſed in this Series

M^n+

$M^1+\frac{n}{1}\times M^{n-1}F+\frac{n}{1}\times\frac{n-1}{2}\times M^{n-2}F^2+\frac{n}{1}\times\frac{n-1}{2}\times\frac{n-2}{3}\times M^{n-3}F^3+$, &c.

It appears plainly, that when the Number of Dice is even there are as many M's as F's in the middle Term of this Series, and in all the other Terms there are moſt M's or moſt F's.

If therefore a Man undertake with an even Number of Dice to throw as many M's as F's, he has all the Terms but the middle Term againſt him; and his Lot is to the Sum of all the Chances, as the coefficient of the middle Term is to the power of 2 raiſed to an exponent equal to the Number of Dice: ſo in Two Dice his Lot is $\frac{2}{4}$ or $\frac{1}{2}$, in Three Dice $\frac{6}{16}$ or $\frac{3}{8}$, in Six Dice $\frac{20}{64}$ or $\frac{5}{16}$, in Eight $\frac{70}{256}$ or $\frac{35}{128}$, &c.

To find this middle Term in any given Power or Number of Dice, continue the Series $\frac{n}{1}\times\frac{n-1}{2}\times\frac{n-2}{3}$, &c. till the number of terms are equal to $\frac{1}{2}n$. For Example, the coefficient of the middle Term of the tenth Power is $\frac{10}{1}\times\frac{9}{2}\times\frac{8}{3}\times\frac{7}{4}\times\frac{6}{5}=252$, the tenth Power uf 2 is 1024, if therefore A. undertakes to throw with Ten Dice in one throw an equal Number of M's and F's, he has 252 Chances out of 1024 for him, that is his Lot is $\frac{252}{1024}$ or $\frac{63}{256}$, which is leſs than $\frac{1}{4}$.

It will be eaſy by the help of Logarithms, to extend this Calculation to a very great Number, but that is not my preſent Deſign. It is viſible from what has been ſaid, that with a very great Number of Dice, A's Lot would become very ſmall; and conſequently (ſuppoſing M to denote Male and F Female) that in the vaſt Number of Mortals, there would be but a ſmall part of all the poſſible Chances, for its happening at any aſſignable time, that an equal Number of Males and Females ſhould be born.

It is indeed to be confeſſed that this Equality of Males and Females is not Mathematical but Phyſical, which alters much the foregoing Calculation; for in this Caſe

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the middle Term will not exactly give A's Chances, but his Chances will take in ſome of the Terms next the middle one, and will lean to one ſide or the other. But it is very improbable (if mere Chance govern'd) that they would never reach as far as the Extremities: But this Event is wiſely prevented by the wiſe Oeconomy of Nature; and to judge of the wiſdom of the Contrivance, we muſt obſerve that the external Accidents to which are Males ſubject (who muſt ſeek their Food with danger) do make a great havock of them, and that this loſs exceeds far that of the other Sex, occaſioned by Diſeaſes incident to it, as Experience convinces us. To repair that Loſs, provident Nature, by the Diſpoſal of its wiſe Creator, brings forth more Males than Females; and that in almoſt a conſtant proportion. This appears from the annexed Tables, which contain Obſervations for 82 Years of the Births in *London*. Now, to reduce the Whole to a Calculation, I propoſe this.

Problem. A lays againſt B, that every Year there ſhall be born more Males than Females: To find A's Lot, or the Value of his Expectation.

It is evident from what has been ſaid, that A's Lot for each Year is leſs than $\frac{1}{2}$; (but that the Argument may be ſtronger) let his Lot be equal to $\frac{1}{2}$ for one Year. If he undertakes to do the ſame thing 82 times running, his Lot will be $\overline{\frac{1}{2}}|^{82}$, which will be found eaſily by the Table of Logarithms to be $\frac{1}{4836\ 0000\ 0000\ 0000\ 0000\ 0000}$. But if A wager with B, not only that the Number of Males ſhall exceed that of Females, every Year, but that this Exceſs ſhall happen in a conſtant Proportion, and the Difference lye within fix'd limits; and this not only for 82 Years, but for Ages of Ages, and not only at *London*, but all over the World; (which 'tis highly probable is Fact, and deſigned that every Male may have a Female of the ſame Country and ſuitable Age) then A's Chance will be near an infinitely ſmall Quantity, at leaſt

leſs

leſs than any aſſignable Fraction. From whence it follows, that it is Art, not Chance, that governs.

There ſeems no more probable Cauſe to be aſſigned in Phyſicks for this Equality of the Births, than that in our firſt Parents Seed there were at firſt formed an equal Number of both Sexes.

Scholium. From hence it follows, that Polygamy is contrary to the Law of Nature and Juſtice, and to the Propagation of Human Race; for where Males and and Females are in equal number, if one *Man* takes Twenty Wives, Nineteen Men muſt live in Celibacy, which is repugnant to the Deſign of Nature; nor is it probable that Twenty Women will be ſo well impregnated by one Man as by Twenty.

	Chriſtened.	
Anno.	*Males.*	*Females.*
1629	5218	4683
30	4858	4457
31	4422	4102
32	4994	4590
33	5158	4839
34	5035	4820
35	5106	4928
36	4917	4605
37	4703	4457
38	5359	4952
39	5366	4784
40	5518	5332
41	5470	5200
42	5460	4910
43	4793	4617
44	4107	3997
45	4047	3919
46	3768	3395
47	3796	3536

	Chriſtened.	
Anno.	*Males.*	*Females.*
1648	3363	3181
49	3079	2746
50	2890	2722
51	3231	2840
52	3220	2908
53	3196	2959
54	3441	3179
55	3655	3349
56	3668	3382
57	3396	3289
58	3157	3013
59	3209	2781
60	3724	3247
61	4748	4107
62	5216	4803
63	5411	4881
64	6041	5681
65	5114	4858
66	4678	4319

Christened.			Christened.		
Anno.	*Males.*	*Females.*	*Anno.*	*Males.*	*Females.*
1667	5616	5322	1689	7604	7167
68	6073	5560	90	7909	7302
69	6506	5829	91	7662	7392
70	6278	5719	92	7602	7316
71	6449	6061	93	7676	7483
72	6443	6120	94	6985	6647
73	6073	5822	95	7263	6713
74	6113	5738	96	7632	7229
75	6058	5717	97	8062	7767
76	6552	5847	98	8426	7626
77	6423	6203	99	7911	7452
78	6568	6033	1700	7578	7061
79	6247	6041	1701	8102	7514
80	6548	6299	1702	8031	7656
81	6822	6533	1703	7765	7683
82	6909	6744	1704	6113	5738
83	7577	7158	1705	8366	7779
84	7575	7127	1706	7952	7417
85	7484	7246	1707	8379	7687
86	7575	7119	1708	8239	7623
87	7737	7214	1709	7840	7380
88	7487	7101	1710	7640	7288